TECHNICAL REPORT 3067

DEVELOPMENT OF THE XM88 ELECTRIC PRIMER

RUTH E. TREZONA

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PICATINNY ARSENAL
DOVER, NEW JERSEY

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AMMUNITION GROUP

DEVELOPMENT OF THE XM88 ELECTRIC PRIMER

BY

RUTH E. TREZONA

AMCMS 5530.12.543A

APRIL 1963

SUBMITTED BY: for D. E. SEEGER
Chief, Explosives Initiation Section

REVIEWED BY: E. H. BUCHANAN
Chief, Artillery Ammunition Laboratory

APPROVED BY: R. W. VOGEL
Chief, Ammunition Development Division

PICATINNY ARSENAL
DOVER, NEW JERSEY

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SECTION I

INTRODUCTION

Design of the XM88 Electric Primer was initiated for use in the PIBD, XM539 Fuze. The delay initiator requirement for this fuze was later cancelled. However, development work was continued on the XM88 for use in Fuzes PIBD, T370, PD, T212 and PD, XM566. During the development the PIBD, T370 Fuze was cancelled and primer development was continued and completed for incorporation in the PD, T212E6 and PD, XM566 Fuzes. These fuzes have been released for industrial engineering.

The XM88 Electric Primer was intended to be a "cut-down" version of the 50-millisecond delay T68 Electric Detonator. Early in the development, however, it was found that a complete redesign was necessary to achieve the required delay reliably and to perform satisfactorily on side initiation.

This report summarizes the development of the XM88, a 50-millisecond delay primer, which initiates a superquick electric detonator with side initiation.

SECTION II

SUMMARY

Development of the XM88 Electric Primer:

A button-contact type primer, designated Primer, Electric XM88 was developed and meets the following design requirements. Also included in this summary are performance characteristics of the primer.

Physical: The maximum dimensions of the primer assembly body are 0.195" diameter and 0.315" long; the contact pin is 0.337" diameter and 0.120" long.

Electrical: The primer has a carbon bridge with 1000 to 10,000 ohms resistance and functions in 50 milliseconds $\pm 25\%$ from the discharge of a 0.004 microfarad capacitor charged to 100 volts.

Output: The primer will initiate a superquick electric detonator by side initiation across a 0.040" air gap.

Performance: Groups of 25 primers functioned satisfactorily at 125° F, -65° F and at ambient after 30 day storage at 160° F; at ambient after being subjected to MIL-STD tests for Jolt, Jumble, Transportation Vibration, Temperature and Humidity Cycle. Twelve primers functioned satisfactorily after being subjected to 30,000 g's in the air gun with primer contact pin positioned forward in line of travel. Eight of 25 failures occurred after the primer was subjected to 30,000 g's

positioned base forward; however, the item for present applications is not positioned to receive the acceleration forces in this manner. Two primers of 25 failed to fire after water immersion; it is believed that improvements can be made in the plug design which will improve the cup-to-case fit and correct the weakness in the seal. No failures occurred in 416 primers fired at ambient indicating a functioning reliability of better then 99.2% at the 95% confidence level. The average firing delay time of all groups tested was 52 milliseconds.

SECTION III

CONCLUSION

The XM88 Electric Primer meets the design and performance requirements for a delay initiator to be used in parallel with a superquick initiator.

SECTION IV

RECOMMENDATION

Studies should be made of methods for improving the design of the plug assembly.

SECTION V

STUDY

The final design of the XM88 Electric Primer is shown in Figures 1-7.

A test fixture was designed conforming to Figure 8. Output tests were conducted by firing the XM88 assembled in the fixture with the RDX lead centered over a lead disc (1.22 dia x 0.135, 8-lb lead). The primer was fired with the discharge of a 0.004-microfarad capacitor charged to 100 volts. In a group of nine primers fired at ambient temperature and a group of ten primers fired at -65° F. the XM88 Primer, in every case, initiated the XM65 Detonator which in turn initiated the RDX lead. Holes produced in the lead disc by the RDX lead were 7/16" diameter minimum.

Groups of primers were fired during the manufacture of the pilot lot. The results are in Table 1. The 122 tested fired in an average time of 55.5 milliseconds with the min. and max. times being 37.2 milliseconds and 61.4 milliseconds, respectively.

Results of evaluation tests of the pilot lot of XM88 Electric Primers are summarized in Table 2. Detailed results are recorded in Tables 3-8.

The knowledge gained in developing the 50-millisecond T68 Electric Detonator on contracts ORD-3183 and ORD-3213 was applied in developing the XM88 Electric Primer. The XM88 is essentially the T68 without the base charge. The T68 was being redesigned when the request was received for a 50-millisecond delay primer for use in the PIBD XM539 Fuze for Shillelagh. Then work on the T68 Detonator was cancelled and the

components on hand were used for development of the XM88 Primer.

One of the problems encountered in designing the pin and plug assembly was the tendency for the insulation around the pin to exude above the surface of the plug when heat or pressure was applied to the plug. This insulation flow usually occurred during the bridging operation when heated under an infra-red lamp. It was found that swaging on the face, (Figure 3) instead of on the side of the contact pin as previously swaged, relieved the pressure which forced the insulation toward the surface to be bridged. This change is an improvement but is not a completely satisfactory design. Even though it improves the exudation problem the swaging operation deforms the outer surface of the plug. The effect of deforming the plug is discussed elsewhere in this study.

The advantages of the machined body (Figure 4) which is used in lieu of a drawn cup are:

A. Charges can be loaded from both ends with the delay mixture in the center consolidated at a higher pressure.

B. For better confinement the portion of the case to hold the delay charge is machined with a thick wall.

C. The portion holding the delay is threaded to prevent movement of the delay column upon high acceleration of the primer and as a deterrent to "blow-through."

After cancellation of the requirements for a delay primer for the Shellelagh program, development of the XM88 Primer for use in Fuzes PIBD T370, PD T212 and PD XM566 continued. To adopt for use in all three fuzes, the length of the primer

was changed from 0.210" - 0.010" to 0.315" - 0.010". The increased length allowed better control over the delay time. More space allows adjustment of the time delay to be made by varying the column length rather than changing the barium chromate/boron mixture which can vary from 88/12 to 92/8.

In testing early groups the delay times were erratic. Investigation revealed that the delay column was cracked on the surface due to movement of the loading fixture during withdrawal of the punch. To correct the condition a spring-loaded punch (Figure 9) was used to hold the loading guide firmly. This change eliminated cracking of the delay column and resulted in more consistent delay times.

Sealing the XM88 Electric Primer is a problem. One disadvantage of using a machined case is that both top and bottom of the primer are crimped and sealed. Since it may be necessary to depend on the surface of the base for one electrical contact a conductive adhesive is used in waterproofing the base. The conductive epoxy adhesive selected is easily applied, has good adhesion, excellent conductivity and does not appear to affect functioning. A good seal at the top depends not only upon a good crimp and an effective sealant but upon the fit of the plug in the case or cup. If the side surface of the plug is deformed in the swaging operation, a poor fit between case and plug could result in a weak seal. The fact that two XM88 Primers in 25 failed after the water test indicates a possible weakness in the plug design. In present applications, however, the primer is sealed in the fuze and waterproofness is not a requirement.

In the pilot lot 416 primers were functioned at ambient temperature with no failure to fire. This result indicates better than a 99.2% reliability with 95% confidence.

APPENDICES

APPENDIX A

TABLES

TABLE I

XM88 Primer Test Results

Functioning Times (milliseconds)

Group No.	No. Tested	No. Failed	$\overline{X}$	High Recorded	Low Recorded	Recorded Times			
1	14	0	58.37	61.37	54.13	61.37	60.16	54.13	58.27
						58.22	55.44	58.17	57.21
						60.74	59.50	57.29	58.97
						60.17	57.52		
2	10	0	55.44	60.69	41.97	59.27	56.23	56.50	41.97
						54.17	57.62	60.69	57.41
						50.85	59.65		
3	9	0	55.45	59.25	53.39	-----	56.22	59.25	53.39
						55.14	54.36	55.61	-----
						54.18			
4	7	0	50.88	54.86	46.65	52.20	-----	54.86	51.08
						48.86	51.67	46.65	
5	7	0	50.97	53.81	44.94	52.11	51.71	44.94	52.19
						53.81	-----	51.04	
6	9	0	48.70	51.94	41.44	49.78	42.11	50.12	51.02
						49.96	41.44	50.72	51.94
						51.26			
7	10	0	47.79	56.41	37.21	39.90	43.13	37.21	52.56
						43.32	48.84	53.13	50.40
						56.41	53.02		
8	9	0	55.23	59.97	49.25	58.23	57.81	51.36	56.07
						49.25	53.60	56.05	59.97
						54.69			
9	10	0	54.18	56.63	50.87	53.99	53.22	56.63	54.14
						56.62	54.32	50.87	55.10
						52.78	54.12		

TABLE I (Continued)

XM88 Primer Test Results

Functioning Times (milliseconds)

Group No.	No. Tested	No. Failed	$\bar{X}$	High Recorded	Low Recorded	Recorded Times			
10	9	0	50.72	53.13	44.31	51.92	53.13	49.98	50.23
						44.31	52.82	52.79	48.73
						52.54			
11	10	0	54.90	58.12	51.97	52.74	54.15	57.77	55.10
						56.62	51.97	54.96	58.12
						54.62	52.92		
12	9	0	56.89	58.04	55.13	55.13	56.78	56.22	57.56
						58.04	56.29	57.22	56.88
						57.87			
13	9	0	52.56	57.23	50.00	53.10	57.23	50.22	52.64
						50.00	52.44	50.52	52.90
						53.98			
Total	122	0	53.53	61.37	37.21 (next low 39.90)				

Notes:

1) Functioning at 100 volts, 0.004 microfarads (200 ergs)
2) Delay powder is 92/8 barium chromate/boron
3) Standard Deviation of functioning delay time is 4.56 and the coefficient of variation, C.V. = 8.5%

TABLE II

PRIMER, ELECTRIC: XM88, EVALUATION TESTS

Condition	Number: Tested at .004 uf/100 V	Number: Failed to Fire	Avg. Resistance, K Ohms: Before Conditioning	Avg. Resistance, K Ohms: After Conditioning	Functioning Time, Milliseconds: Minimum	Functioning Time, Milliseconds: Average	Functioning Time, Milliseconds: Maximum	Functioning Time, Milliseconds: Standard Deviation	Coefficient of Variation	No. Items Functioning Out of Spec. Range: Less than 37 millisec	No. Items Functioning Out of Spec. Range: Greater than 62 millisec
Water Immersion (under 12"/24 hrs)	25	2	2.21	2.2[illegible]	16.97	49.21 (1)	54.36	2.55	5.2%	1	0
Hot Functioning (after 18 hrs at 125° F)	25	0	2.18	2.92 (2)	45.42	49.63	52.65	1.78	3.6%	0	0
Cold Functioning (after 6 hrs at -65° F)	25	0	2.05	2.[illegible]3	44.25	49.94	54.40	2.75	5.1%	0	0
Hot Storage (30 days at 160° F)	25	0	2.54	3.[illegible]1	36.85	53.05 (4)	60.18	5.28	9.9%	1	0
Transportation Vibration MIL-STD-303	25	0	3.08	3.27	46.24	52.36	60.23	3.22	6.1%	0	0
Temp. & Humidity Cyc MIL-STD-304	25	0	2.22	3.75 (3)	24.32	50.37 (4)	65.20	10.47 (4)	20.8%	3	1
Acceleration to 30K G's Button Forward	12	0	2.34	2.56	40.88	48.26	53.04	3.22	6.7%	0	0
Acceleration to 30K G's Base Forward	12	8	2.35	(5)	38.29	41.40	45.03			0	0
Jolt, MIL-STD-300	25	0 (6)	2.61	3.32	22.11	59.01 (4)	72.45	8.91	15.0%	1	6
Jumble, MIL-STD-301	25	0	2.21	2.61	46.84	58.09 (4)	66.34	4.35	7.5%	0	4
Unconditioned Ambient	416	0	2.75 (7)		25.81	52.17 (4)	67.12	5.30 (4)	10.1%	1	15

TABLE II (Continued)

XM88 Primer Test Results

NOTES:

1. Omitted the out-of-spec. time of 16.97 milliseconds in calculations
2. Omitted the out-of-spec resistance of 13.0 K ohms in calculations
3. Omitted out-of-spec resistances of 16.0, 12.0 and 29.0K ohms in calculations
4. Included the out-of-spec times in the calculations
5. Except for one resistance of 1.2 K ohms the average was 334 K ohms and ranged from 15K ohms to 600 K ohms
6. Two primer cases were damaged during jolt. However, resistances were normal and they functioned in 22.11 and 60.35 milliseconds.
7. Omitted out-of-spec resistances (18K, 16K, 12K ohms) in calculations.

TABLE III

XM88 Electric Primer

Ambient Functioning at 0.004 uf/100V

No.	Resistance, Kilohm	Functioning Time, Millisec	No.	Resistance, Kilohm	Functioning Time, Millisec
1	1.1	50.53	27	2.7	49.28
2	4.0	52.71	28	4.4	49.36
3	3.2	50.31	29	2.1	50.46
4	1.8	48.43	30	1.6	53.97
5	2.8	Lost	31	1.3	54.03
6	1.5	46.69	32	1.2	51.92
7	2.1	48.71	33	1.4	43.63
8	8.1	50.28	34	2.0	58.55
9	2.9	51.73	35	2.3	59.74
10	1.9	Lost	36	0.7	67.12
11	1.0	49.61	37	1.6	67.00
12	1.4	51.95	38	2.4	60.08
13	1.5	49.49	39	1.0	53.54
14	4.2	51.14	40	3.1	56.59
15	2.1	45.69	41	1.3	56.75
16	2.1	49.04	42	1.9	51.98
17	2.0	52.26	43	2.4	58.10
18	3.2	52.98	44	1.8	57.12
19	2.2	47.81	45	1.7	62.93
20	2.2	49.92	46	3.0	57.87
21	1.2	48.16	47	1.3	53.99
22	4.8	49.51	48	1.0	52.84
23	5.2	37.29	49	5.2	52.54
24	3.3	50.92	50	3.0	53.96
25	2.5	49.20	51	4.5	56.00
26	7.8	57.79	52	2.8	54.03

TABLE III (Continued)

XM88 Electric Primer

Ambient Functioning at 0.004 uf/100V

No.	Resistance, Kilohms	Functioning Time, Millisec	No.	Resistance, Kilohms	Functioning Time, Millisec
53	2.1	52.85	79	1.3	52.42
54	4.6	53.01	80	1.7	42.04
55	1.8	56.23	81	2.1	48.51
56	1.8	52.32	82	4.5	52.58
57	1.2	53.82	83	1.8	54.69
58	2.0	51.33	84	1.2	50.51
59	1.2	49.89	85	3.2	Lost
60	2.1	50.11	86	12.0	Lost
61	4.9	50.16	87	3.4	37.18
62	5.4	48.69	88	2.5	49.60
63	1.9	51.03	89	3.3	50.22
64	1.7	Lost	90	1.8	51.84
65	4.0	49.19	91	2.0	53.87
66	4.5	47.30	92	1.2	48.31
67	4.0	42.11	93	1.7	54.29
68	2.3	51.79	94	2.1	53.96
69	8.9	48.33	95	2.9	48.82
70	1.2	Lost	96	8.5	Lost
71	3.6	56.52	97	1.6	51.80
72	5.4	50.44	98	2.0	50.82
73	2.7	54.15	99	2.8	47.57
74	1.2	55.20	100	2.2	49.82
75	2.0	42.13	101	1.2	52.71
76	3.8	51.20	102	1.6	53.68
77	3.4	52.86	103	4.5	54.29
78	3.1	37.95	104	2.3	51.63

TABLE III (Continued)

XM88 Electric Primer

Ambient Functioning at 0.004uf/100V

No.	Resistance, Kilohms	Functioning Time, Millisec	No.	Resistance, Kilohms	Functioning Time, Millisec
105	2.1	Lost	131	1.5	47.00
106	3.0	53.45	132	2.7	47.32
107	1.5	50.83	133	0.9	48.48
108	1.3	49.38	134	1.6	49.31
109	4.2	50.49	135	1.8	47.90
110	2.2	51.12	136	6.6	42.05
111	3.3	51.20	137	1.9	47.35
112	1.9	51.79	138	1.7	51.28
113	0.9	Lost	139	1.5	46.49
114	1.7	51.44	140	2.1	49.23
115	1.2	53.96	141	1.3	48.21
116	1.7	55.35	142	1.5	51.32
117	1.5	50.96	143	1.8	55.17
118	4.9	52.85	144	2.2	50.93
119	2.1	52.87	145	1.8	38.91
120	4.8	49.93	146	2.3	48.39
121	2.1	51.79	147	1.4	47.54
122	1.8	49.45	148	2.4	47.55
123	3.1	52.21	149	1.3	46.62
124	3.9	49.50	150	2.3	51.37
125	1.8	49.26	151	1.7	37.50
126	3.7	50.99	152	5.1	49.19
127	1.6	48.00	153	2.3	49.35
128	3.2	48.78	154	2.0	44.59
129	2.9	47.97	155	2.2	45.11
130	2.3	47.56	156	6.5	48.18

TABLE III (Continued)

XM88 Electric Primer

Ambient Functioning at 0.004 uf/100V

No.	Resistance, Kilohms	Functioning Time, Millisec	No.	Resistance, Kilohms	Functioning Time, Millisec
157	1.4	48.60	183	8.0	50.14
158	4.0	48.62	184	2.4	52.59
159	3.0	47.58	185	3.7	50.55
160	1.5	41.68	186	3.5	48.76
161	1.1	48.80	187	1.8	48.79
162	2.1	43.17	188	2.9	48.24
163	1.7	50.28	189	4.3	49.45
164	2.9	49.46	190	8.8	54.07
165	1.4	45.66	191	2.2	50.92
166	1.5	51.55	192	3.4	Lost
167	3.6	47.60	193	1.8	44.63
168	2.2	50.30	194	4.9	Lost
169	1.7	49.21	195	1.3	51.02
170	1.5	47.83	196	4.4	50.91
171	1.2	46.46	197	1.8	Lost
172	2.1	49.37	198	17.0	51.50
173	3.6	49.71	199	1.1	Lost
174	2.5	47.52	200	2.4	Lost
175	1.2	47.61	201	1.0	48.03
176	1.2	50.63	202	1.1	53.05
177	2.7	49.84	203	1.0	Lost
178	2.1	46.10	204	1.3	54.34
179	8.9	47.02	205	1.6	54.22
180	1.9	46.91	206	1.7	54.22
181	1.8	52.78	207	3.4	56.52
182	2.0	55.63	208	1.1	53.46

TABLE III (Continued)

XM88 Electric Primer

Ambient Functioning at 0.004 uf/100V

No.	Resistance, Kilohms	Functioning Time, Millisec	No.	Resistance, Kilohms	Functioning Time, Millisec
209	3.0	57.63	235	3.0	55.31
210	2.4	49.06	236	4.5	51.34
211	4.1	56.50	237	1.3	59.15
212	1.2	55.51	238	1.6	54.35
213	2.8	53.65	239	1.0	44.60
214	2.8	56.64	240	3.2	57.71
215	2.7	56.34	241	1.8	51.80
216	2.7	50.55	242	6.0	58.66
217	2.8	61.03	243	18.0	58.94
218	4.1	58.02	244	3.0	58.02
219	1.6	56.74	245	2.1	60.52
220	2.4	53.77	246	3.2	54.01
221	1.5	52.28	247	2.8	44.15
222	4.0	53.21	248	1.1	50.35
223	1.4	56.25	249	1.3	58.33
224	1.2	53.21	250	2.0	47.05
225	3.2	51.96	251	2.6	54.51
226	1.3	55.70	252	2.4	46.19
227	2.0	54.95	253	3.6	43.66
228	1.2	47.55	254	4.5	50.22
229	1.8	43.15	255	2.0	52.06
230	3.8	46.92	256	8.1	53.46
231	2.7	58.06	257	1.6	57.02
232	1.2	57.26	258	6.7	51.51
233	4.8	48.18	259	10.0	52.87
234	1.9	55.61	260	2.7	25.81

TABLE III (Continued)

XM88 Electric Primer

Ambient Functioning at 0.004uf/100V

No.	Resistance, Kilohms	Functioning Time, Millisec	No.	Resistance, Kilohms	Functioning Time, Millisec
261	1.4	55.37	287	1.8	62.15
262	0.6	53.22	288	2.0	57.20
263	8.0	39.30	289	1.7	57.76
264	3.1	54.56	290	1.2	Lost
265	1.2	53.79	291	2.9	52.60
266	1.4	49.79	292	4.5	63.77
267	3.0	49.99	293	1.0	64.48
268	2.3	54.06	294	1.3	66.06
269	3.9	52.37	295	3.0	59.08
270	3.8	49.72	296	3.3	61.30
271	2.6	55.15	297	4.1	Lost
272	4.6	Lost	298	1.9	51.90
273	2.1	52.37	299	6.2	57.28
274	4.3	51.28	300	1.5	47.72
275	5.6	56.13	301	1.3	50.42
276	5.7	47.45	302	1.2	57.36
277	2.0	50.18	303	1.8	65.32
278	6.4	53.09	304	1.2	56.15
279	1.7	Lost	305	2.8	53.21
280	4.6	Lost	306	7.7	51.47
281	2.6	58.89	307	2.1	57.17
282	7.1	Lost	308	3.0	64.15
283	1.9	Lost	309	2.8	57.20
284	5.1	56.22	310	3.8	54.93
285	1.2	62.22	311	4.6	57.83
286	3.6	53.91	312	2.0	63.66

TABLE III (Continued)

XM88 Electric Primer

Ambient Functioning at 0.004 uf/100V

No.	Resistance, Kilohms	Functioning Time, Millisec	No.	Resistance, Kilohms	Functioning Time, Millisec
313	3.1	57.97	339	2.1	46.10
314	2.2	54.77	340	8.9	47.02
315	1.1	53.21	341	1.9	46.91
316	4.8	55.79	342	6.4	53.09
317	3.5	43.01	343	1.7	Lost
318	1.1	58.77	344	4.6	Lost
319	2.5	61.46	345	2.6	58.89
320	2.2	54.23	346	7.1	Lost
321	2.0	58.65	347	1.9	Lost
322	2.6	49.12	348	5.1	56.22
323	1.4	59.01	349	1.2	62.22
324	4.8	56.86	350	3.6	53.91
325	2.5	56.67	351	1.8	62.15
326	2.8	57.40	352	2.0	57.20
327	1.5	51.55	353	1.7	57.76
328	3.6	47.60	354	1.2	Lost
329	2.2	50.30	355	2.9	52.60
330	1.7	49.21	356	4.5	63.77
331	1.5	47.83	357	1.0	64.48
332	1.2	46.46	358	1.3	66.06
333	2.1	49.37	359	3.0	59.08
334	3.6	49.71	360	3.3	61.30
335	2.5	47.52	361	4.1	Lost
336	1.2	47.61	362	1.9	51.90
337	1.2	50.63	363	6.2	57.28
338	2.7	49.84	364	1.5	47.72

TABLE III (Continued)

XM88 Electric Primer

Ambient Functioning at 0.004 uf/100V

No.	Resistance, Kilohms	Functioning Time, Millisec	No.	Resistance, Kilohms	Functioning Time, Millisec
365	1.3	50.42	391	2.8	57.40
366	1.2	57.36	392	3.8	53.19
367	1.8	65.32	393	7.7	Lost
368	1.2	56.15	394	2.0	47.20
369	2.8	53.21	395	4.0	Lost
370	7.7	51.47	396	1.5	Lost
371	2.1	57.17	397	2.2	52.06
372	3.0	64.15	398	2.1	50.86
373	2.8	57.20	399	2.7	47.75
374	3.8	54.93	400	1.6	50.80
375	4.6	57.83	401	3.1	45.37
376	2.0	63.66	402	5.2	48.41
377	3.1	57.97	403	3.2	45.95
378	2.2	54.77	404	1.7	51.46
379	1.1	53.99	405	1.7	46.53
380	4.0	55.21	406	1.8	48.08
381	4.8	55.79	407	1.5	50.57
382	3.5	43.01	408	2.9	48.57
383	1.1	58.77	409	1.5	47.74
384	2.5	61.46	410	4.5	48.36
385	2.2	54.23	411	1.9	48.21
386	2.0	58.65	412	1.4	46.25
387	2.6	49.12	413	1.5	48.81
388	1.4	59.01	414	5.0	50.66
389	4.8	56.86	415	3.0	48.60
390	2.5	56.67	416	6.6	49.50

TABLE IV

XM88 Electric Primer

Firing Energy 0.004 uf/100V

	Water Immersion Test (Under 12" for 24 hrs)			Hot Storage Test (30 days @ 160° F)	
No.	Resistance, Kilohm	Functioning Time, Millisec	No.	Resistance, Kilohm	Functioning Time, Millisec
1	2.2	16.97	1	3.6	58.19
2	3.7	54.36	2	2.7	46.33
3	2.0	51.72	3	3.9	55.52
4	1.9	Failed	4	2.9	55.10
5	1.7	48.80	5	1.1	51.39
6	3.2	50.77	6	1.5	58.33
7	2.1	Failed	7	3.2	36.85
8	1.6	Lost	8	2.8	58.70
9	1.6	50.92	9	2.2	53.05
10	1.7	50.32	10	3.3	60.18
11	1.3	47.58	11	2.1	Lost
12	3.9	46.32	12	8.4	53.90
13	2.1	48.60	13	2.7	57.63
14	1.3	51.00	14	5.5	53.77
15	4.2	45.48	15	3.6	47.95
16	1.3	44.08	16	1.7	50.35
17	1.7	48.60	17	1.9	48.66
18	1.2	49.46	18	2.7	56.91
19	2.3	45.85	19	1.8	Lost
20	3.1	46.32	20	1.3	50.41
21	4.7	49.98	21	7.3	53.01
22	1.2	52.58	22	4.2	47.32
23	1.1	50.87	23	1.8	53.44

TABLE IV (Continued)

XM88 Electric Primer

Firing Energy 0.004 uf/100V

Water Immersion Test (Under 12" for 24 hrs)			Hot Storage Test (30 days @ 160° F)		
No.	Resistance, Kilohm	Functioning Time, Millisec	No.	Resistance, Kilohm	Functioning Time, Millisec
24	2.7	49.57	24	2.1	56.80
25	1.4	50.25	25	6.0	56.38
Avg	2.29	49.21 (w/o #1)	Avg	3.21	53.05

TABLE V

XM88 Electric Primer

Firing Energy 0.004 uf/100V

Hot Functioning Test (After 18 hrs at 125° F)			Cold Functioning Test (After 6 hrs at -65° F)		
No.	Resistance, Kilohms	Functioning Time, Millisec	No.	Resistance, Kilohms	Functioning Time, Millisec
1	1.7	49.46	1	1.5	Lost
2	5.2	50.80	2	1.2	51.09
3	2.8	51.09	3	1.4	53.54
4	1.0	50.50	4	1.4	46.34
5	3.0	50.40	5	2.5	49.00
6	2.3	48.16	6	2.9	54.40
7	2.9	50.98	7	1.2	52.33
8	1.7	50.15	8	4.1	49.67
9	1.7	50.39	9	1.3	50.17
10	2.4	49.31	10	3.4	47.33
11	2.2	48.13	11	1.6	Lost
12	4.0	45.42	12	1.7	51.40
13	4.7	49.89	13	2.8	53.20
14	1.2	50.24	14	2.0	47.57
15	2.1	51.18	15	3.0	48.42
16	3.6	45.58	16	1.4	50.00
17	5.9	50.89	17	1.8	53.47
18	5.6	52.65	18	2.9	46.68
19	2.7	49.24	19	1.0	51.59
20	3.8	48.47	20	1.7	44.25
21	3.1	48.75	21	1.2	51.22
22	3.5	51.18	22	2.7	46.70
23	13.0	46.96	23	3.2	Lost

TABLE V (Continued)

XM88 Electric Primer

Firing Energy 0.004 uf/100V

Hot Functioning Test (After 18 hrs at 125° F)			Cold Functioning Test (After 6 hrs at -65° F)		
No.	Resistance, Kilohms	Functioning Time, Millisec	No.	Resistance, Kilohms	Functioning Time, Millisec
24	2.7	51.76	24	1.8	50.42
25	2.9	49.22	25	1.0	Lost
Avg	2.92 (w/o #23)	49.63	Avg	2.03	49.94

TABLE VI

XM88 Electric Primer

Firing Energy 0.004 uf/100V

Jolt Test (MIL-STD-300)			Jumble Test (MIL-STD-301)		
No.	Resistance, Kilohm	Functioning Time, Millisec	No.	Resistance, Kilohm	Functioning Time, Millisec
1	2.8	58.60	1	1.7	55.45
2	3.4	52.22	2	1.2	53.76
3	1.6	63.92	3	2.3	56.03
4	2.7*	22.11	4	5.9	56.65
5	4.0	56.81	5	1.6	46.84
6	2.7	60.83	6	1.7	60.81
7	9.5	62.33	7	1.2	65.34
8	1.8	62.46	8	4.7	57.67
9	6.5*	60.35	9	1.1	56.40
10	1.8	58.84	10	3.0	55.50
11	9.2	65.25	11	2.0	56.71
12	2.3	58.76	12	1.0	59.35
13	2.2	67.84	13	5.0	58.22
14	2.2	59.51	14	2.7	61.22
15	6.1	58.04	15	2.0	62.71
16	1.7	51.73	16	3.4	51.53
17	1.6	72.45	17	6.3	57.55
18	1.5	59.01	18	1.8	54.81
19	2.1	58.25	19	2.6	57.31
20	1.8	60.66	20	3.6	60.68
21	1.2	65.10	21	1.8	63.53
22	4.5	64.75	22	2.2	66.34
23	1.1	57.96	23	1.0	57.69

TABLE VI (Continued)

XM88 Electric Primer

Firing Energy 0.004 uf/100V

Jolt Test (MIL-STD-300)			Jumble Test (MIL-STD-301)		
No.	Resistance, Kilohm	Functioning Time, Millisec	No.	Resistance, Kilohm	Functioning Time, Millisec
24	6.2	62.01	24	1.2	63.64
25	2.4	55.55	25	4.3	56.63
Avg	3.32	59.01	Avg	2.61	58.09

*Case was battered

TABLE VII

XM88 Electric Primer

Firing Energy 0.004 uf/100V

Transportation Vibration, MIL-STD-303			Temperature & Humidity Cycle 28 day, MIL-STD-304		
No.	Resistance, Kilohms	Functioning Time, Millisec	No.	Resistance, Kilohms	Functioning Time, Millisec
1	5.0	57.03	1	2.4	44.54
2	1.0	54.32	2	2.8	37.05
3	2.0	52.26	3	3.1	48.27
4	3.0	50.86	4	1.1	50.54
5	10.0	56.61	5	12.0	54.39
6	3.6	48.76	6	1.5	55.32
7	3.4	52.78	7	2.4	44.62
8	6.3	53.95	8	3.1	26.58
9	6.3	60.23	9	6.3	50.95
10	6.2	49.21	10	1.4	53.94
11	7.5	54.40	11	3.5	53.29
12	2.6	49.58	12	2.8	50.11
13	2.5	47.81	13	2.0	60.68
14	3.3	52.79	14	1.9	52.54
15	1.3	51.94	15	3.3	59.33
16	4.3	46.24	16	3.0	65.20
17	2.9	50.90	17	6.3	61.53
18	2.0	49.28	18	7.1	52.95
19	1.0	51.68	19	2.3	60.11
20	1.8	53.62	20	4.3	53.76
21	1.4	51.20	21	16.0	32.56
22	1.0	51.52	22	10.0	24.32
23	1.6	55.01	23	9.2	57.04

TABLE VII (Continued)

XM88 Electric Primer

Firing Energy 0.004 uf/100V

	Transportation Vibration, MIL-STD-303			Temperature & Humidity Cycle 28 day, MIL-STD-304	
No.	Resistance, Kilohm	Functioning Time, Millisec	No.	Resistance, Kilohm	Functioning Time, Millisec
24	1.3	56.60	24	2.6	58.25
25	1.5	50.39	25	29.0	51.48
Avg	3.27	52.36	Avg	3.27 w/o #5, 21, 25	50.37

TABLE VIII

XM88 Electric Primer

Firing Energy 0.004uf/100V

Air Gun Tests, 30,000 G's Acceleration
Pin Contact Forward in line of travel

No.	Resistance, Kilohms	Functioning Time, Millisec
1	1.8	44.34
2	1.9	49.75
3	1.8	47.84
4	1.4	48.48
5	4.0	50.16
6	1.0	49.11
7	6.0	50.75
8	2.2	50.31
9	1.8	53.04
10	1.2	46.14
11	3.0	40.88
12	4.7	48.30
Avg	2.56	48.26

Base Forward in line of travel

No.	Resistance, Kilohms	Functioning Time, Millisec
1	1.2	38.29
2	OPEN	-----
3	OPEN	-----
4	100.0	43.25
5	OPEN	-----
6	OPEN	-----
7	OPEN	-----
8	OPEN	-----
9	OPEN	-----
10	20.0	39.01
11	15.0	45.03
12	OPEN	-----
Avg	----	-----

APPENDIX B

FIGURES

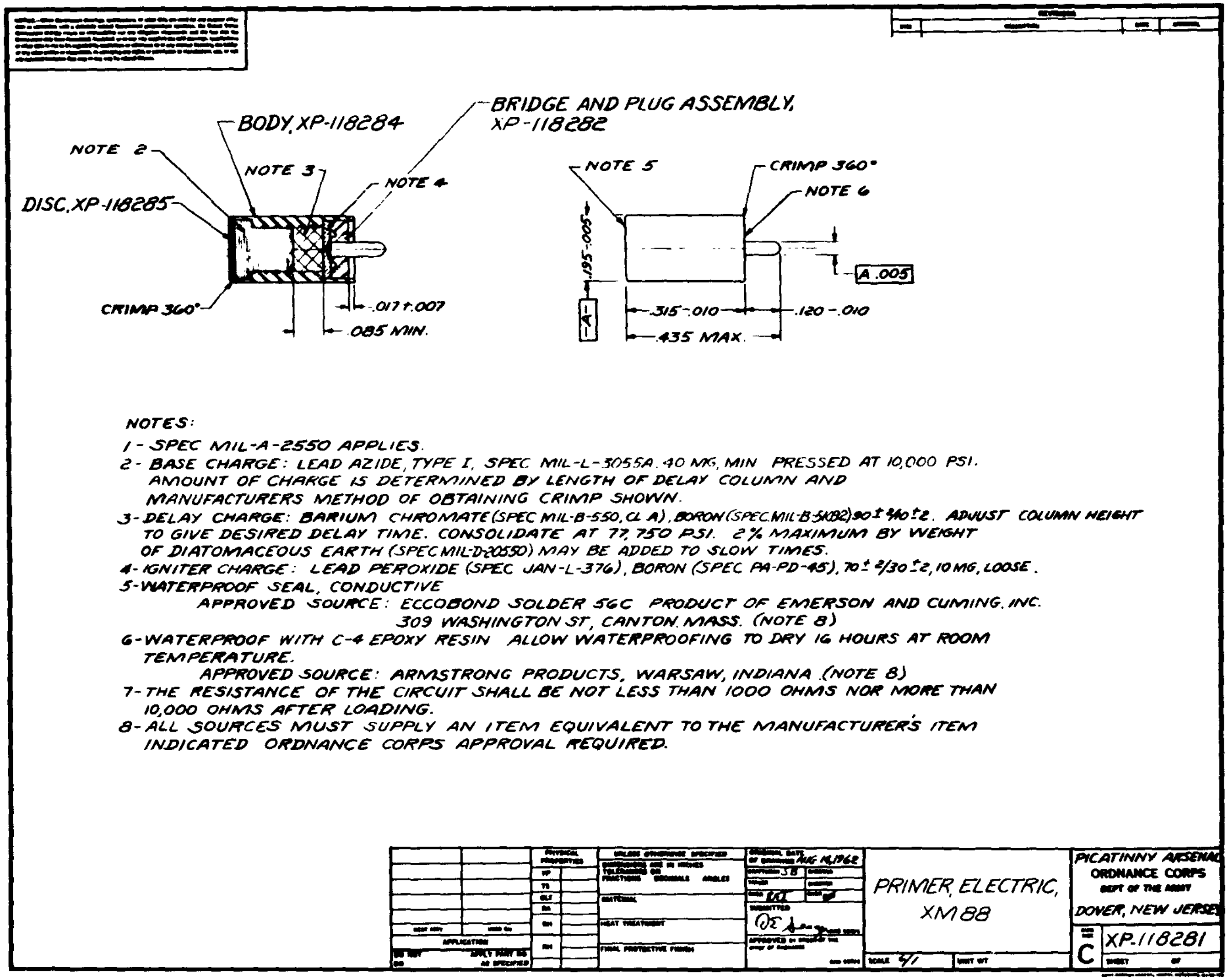
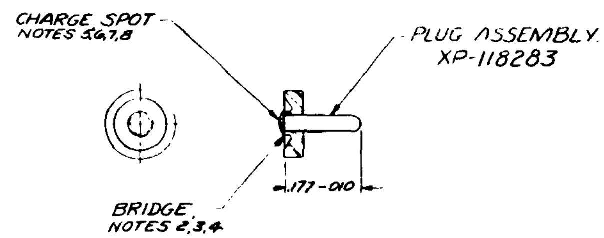


Figure 1. Primer, Electric, XM88



NOTES.

1 - SPEC MIL-A-2550 APPLIES

2 - BRIDGE MATERIAL: SOLIDS - COLLOIDAL GRAPHITE (AQUADAG - SEE NOTE 11) ---------- .5% ±.1%
DISPERSING AGENT ---------- 99.5% ±1.0%
BATTERY WATER, SPEC O-W-41 ---------- 99%
AMMONIUM HYDROXIDE CL A, SPEC MIL-A-10165 ---- 1%

3 - BEFORE AND DURING APPLICATION OF BRIDGE MATERIAL, THE BUTTON SHALL BE HEATED AND MAINTAINED AT A TEMPERATURE OF APPROX 120°F

4 - BRIDGE SHALL BE AS SMALL AS POSSIBLE CONSISTENT WITH THE FORMATION OF AN ADEQUATE BRIDGE. THE BRIDGE SHALL BE DRIED QUICKLY UNDER INFRARED LAMPS (120°F) TO OBTAIN A UNIFORMLY DISPERSED GRAPHITE SURFACE

5 - SPOT CHARGE: .15CC CLEAR LACQUER (NOTE 6) AND .35CC BUTYL ACETATE, SPEC TT-B-838, PER GRAM OF LEAD STYPHNATE, SPEC PA-PD-160. MILL LEAD STYPHNATE 24 HOURS IN ETHYL ALCOHOL

6 - CLEAR LACQUER CONSISTS OF
SOLIDS ---------- 14.4%
1. CAMPHOR USP, MELTING POINT 176° TO 180° C COMMERCIAL (NOTE 9) ---- 19.6%
2. NITROCELLULOSE, RS 60-80 SEC COMMERCIAL (NOTE 10) ---- 28.0
3. NITROCELLULOSE, TYPE II, SPEC MIL-N-5538 - 52.4
SOLVENT: ---------- 85.6%
1. BUTYL ACETATE, SPEC TT-B-838 - 72.2%
2. ETHYL ALCOHOL, GR III SPEC O-A-396, FORMULA 3A OR 2B — 24.8%

7 - SPOT CHARGE SHALL BE FREE OF CRACKS, VOIDS AND SEPARATIONS

8 - SPOT CHARGE IS NOT TO BE APPLIED MORE THAN 72 HOURS BEFORE ASSEMBLY (XP-118281)

9 - APPROVED SOURCE: E.I. DUPONT DE NEMOURS, WILMINGTON, DELAWARE (NOTE 12)

10 - APPROVED SOURCE: HERCULES POWDER CO, WILMINGTON, DELAWARE (NOTE 12)

11 - APPROVED SOURCE: ACHESON COLLOIDS CORP 4618 WASHINGTON AVE, PORT HURON, MICH. (NOTE 12)

12 - ALL SOURCES MUST SUPPLY AN ITEM EQUIVALENT TO THE MANUFACTURER'S ITEM INDICATED. ORDNANCE CORPS APPROVAL REQUIRED

ORDNANCE PART NO.

XP-118281 PRIMER ELEC.

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

MATERIAL

HEAT TREATMENT

FINAL PROTECTIVE FINISH

ORIGINAL DATE OF DRAWING AUG 14, 1962

BRIDGE AND PLUG ASSEMBLY

SCALE 4/1

PICATINNY ARSENAL
ORDNANCE CORPS
DEPT OF THE ARMY
DOVER, NEW JERSEY

C XP-118282

Figure 2. Bridge And Plug Assembly

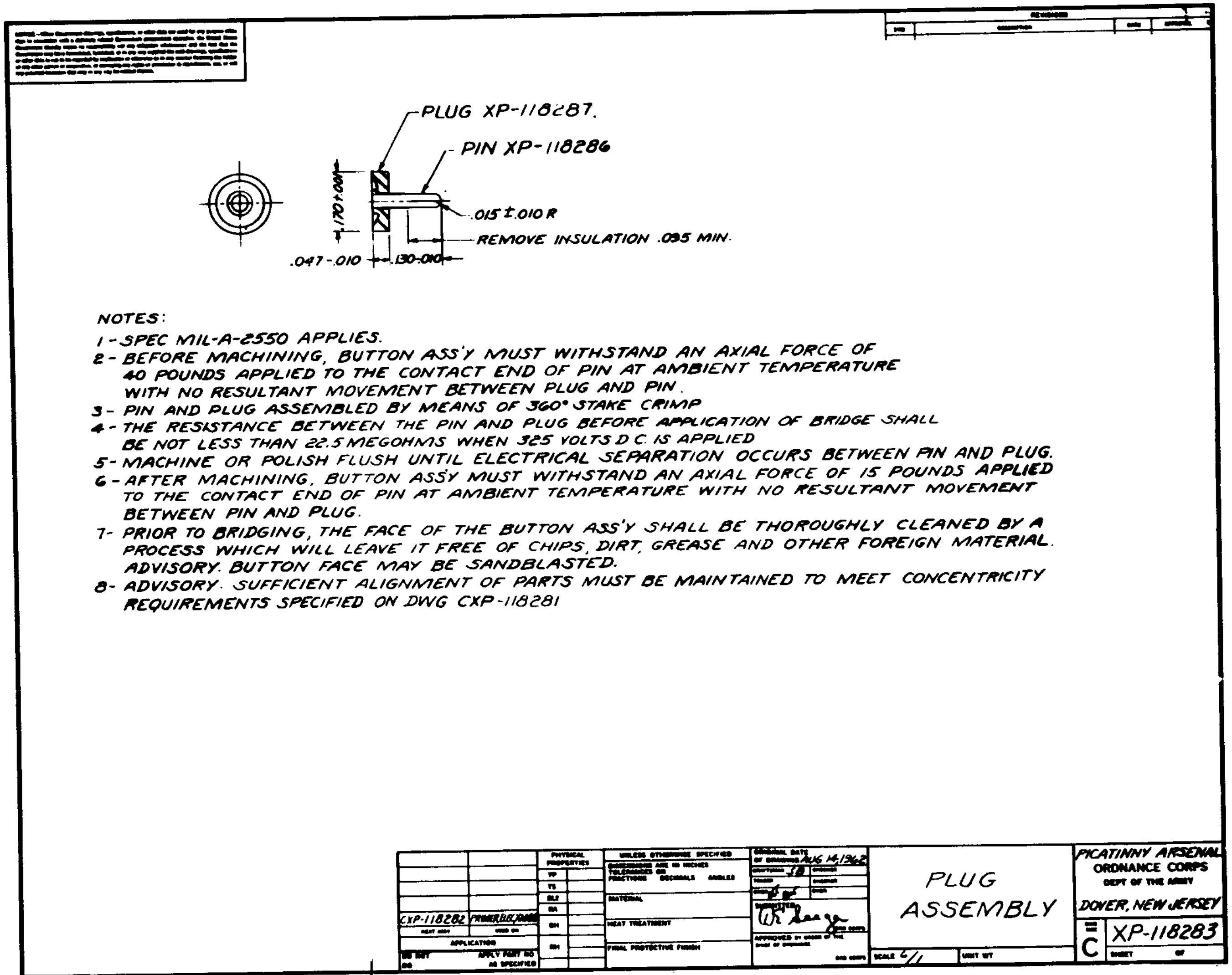


Figure 3. Plug Assembly

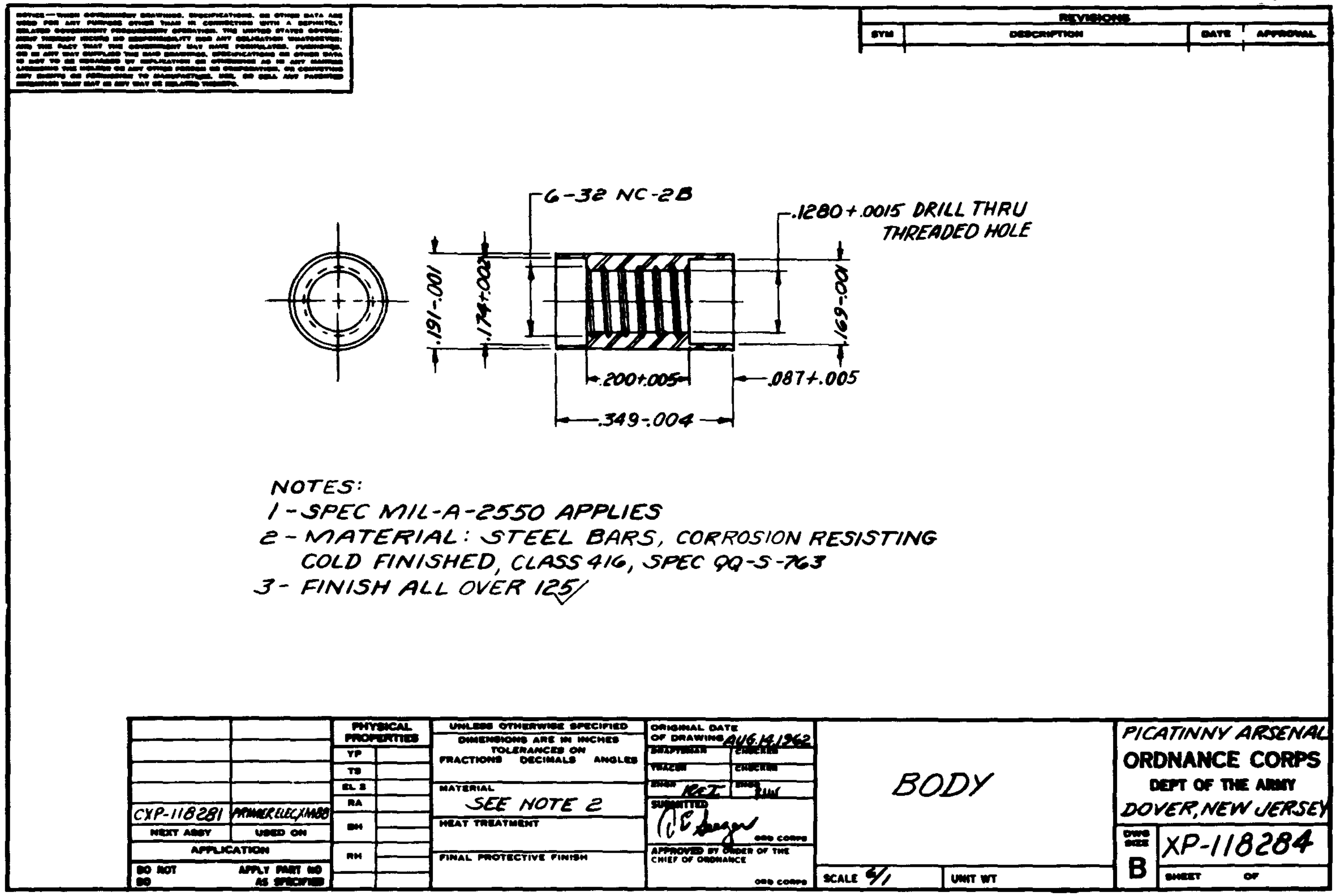
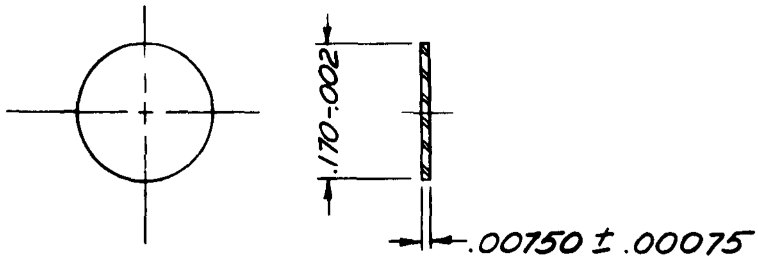


Figure 4. Body

PHYSICAL PROPERTIES		APPLICATION		AXP-118285			
		NEXT ASSY	USED ON	REVISIONS			
YP				SYM	DESCRIPTION	DATE	APPROVAL
TS							
EL2							
RA							
BH		CXP-118281	PRIMER, ELEC, XM88				
RH		SEE ENGINEERING RECORDS					
		DO NOT	APPLY PART NO.				
		DO	AS SPECIFIED				



NOTES:

1-SPEC MIL-A-2550 APPLIES

2-MATERIAL: STEEL, STRIP, CL2, SPEC QQ-S-766, COND A.

3-SLIGHT BOW AND BURR PERMITTED FROM PUNCHING OPERATION.

ORDNANCE PART NO.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON- DECIMALS FRACTIONS ANGLES	ORIGINAL DATE OF DRAWING AUG. 14, 1962	DISC, BOTTOM	PICATINNY ARSENAL ORDNANCE CORPS DEPT OF THE ARMY DOVER, NEW JERSEY
MATERIAL SEE NOTE 2	DRAFTSMAN / CHECKER / TRACER / CHECKER / ENGR / ENGR		DWG SIZE A — XP-118285
HEAT TREATMENT	SUBMITTED ORD CORPS		SHEET OF
FINAL PROTECTIVE FINISH	APPROVED BY ORDER OF THE CHIEF OF ORDNANCE ORD CORPS	SCALE 4/1 UNIT WT	

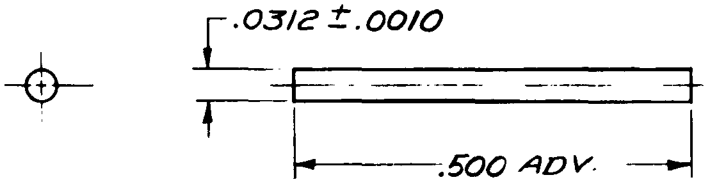
Figure 5. Disc, Bottom

AXP-118286

MATERIAL PROPERTIES		APPLICATION	
		NEXT ASSY	USED ON
YP			
TS			
EL2			
RA			
BH			
		CXP-118285	PRIMER, ELEC, XM88
RH		SEE ENGINEERING RECORDS	
		DO NOT	APPLY PART NO.
		DO	AS SPECIFIED

REVISIONS

SYM	DESCRIPTION	DATE	APPROVAL



NOTES:

1 - SPEC MIL-A-2550 APPLIES.
2 - MATERIAL: STEEL, CORROSION RESISTING, COMP 304, SPEC QQ-W-423 COND A.
3 - COAT PIN WITH LECTON ACRYLIC RESIN INSULATION .0010±.0005 ON RADIUS. (NOTE 4)
4 - APPROVED SOURCE: E.I. DUPONT, WILMINGTON, DEL. ALL SOURCES MUST SUPPLY AN ITEM EQUIVALENT TO THE MANUFACTURER'S ITEM INDICATED. ORDNANCE CORPS APPROVAL REQUIRED.

ORDNANCE PART NO.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON.
DECIMALS
FRACTIONS
ANGLES

MATERIAL SEE NOTE 2

HEAT TREATMENT

FINAL PROTECTIVE FINISH

ORIGINAL DATE OF DRAWING AUG 14, 1962
DRAFTSMAN | CHECKER
TRACER | CHECKER
ENGR | ENGR
SUBMITTED
ORD CORPS
APPROVED BY ORDER OF THE CHIEF OF ORDNANCE
ORD CORPS

PIN

SCALE 6/1 | UNIT WT

PICATINNY ARSENAL
ORDNANCE CORPS
DEPT OF THE ARMY
DOVER, NEW JERSEY

DWG SIZE A | XP-118286
SHEET | OF

Figure 6. Pin

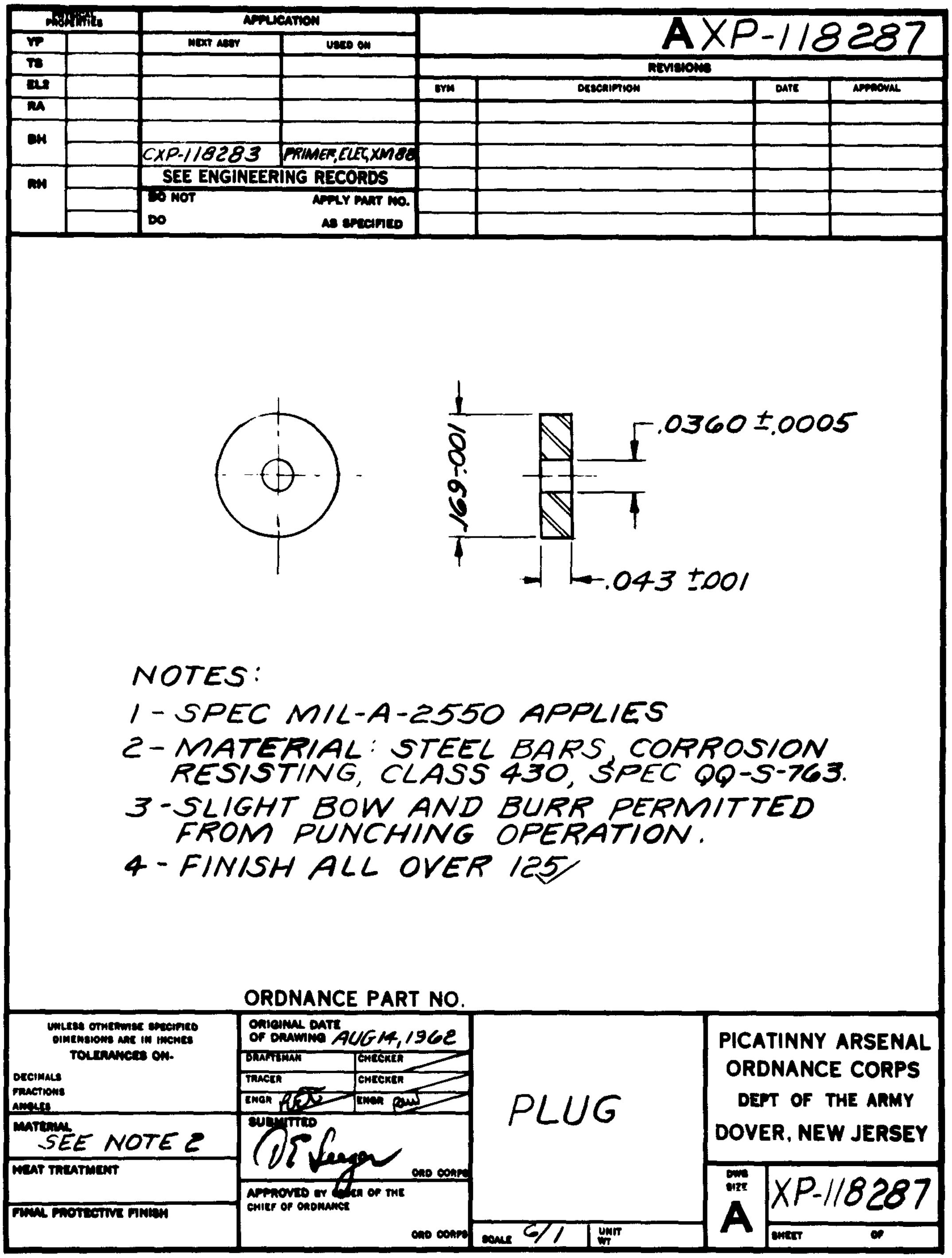


Figure 7. Plug

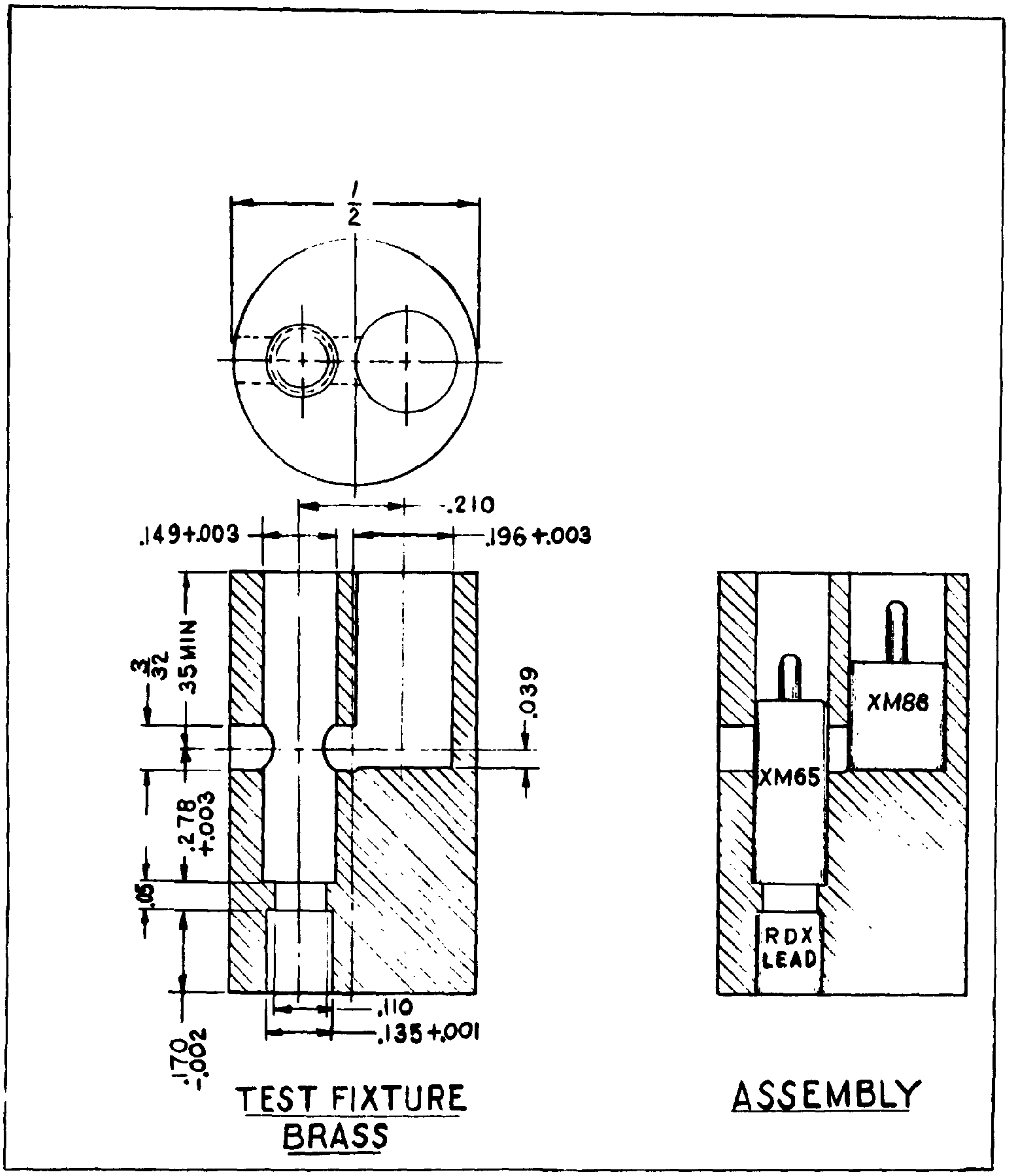


Figure 8. Output Test Set-Up

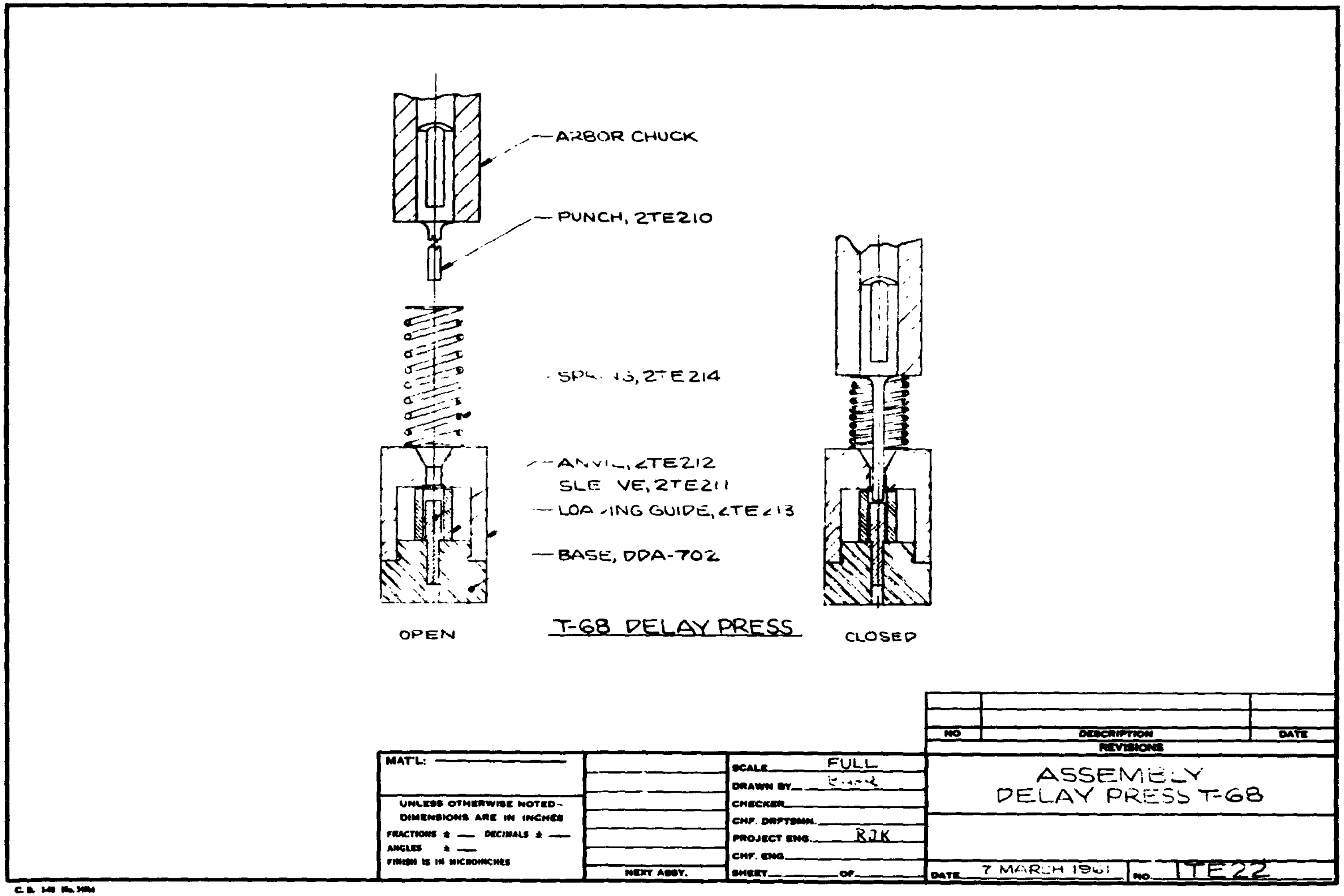


Figure 9. Assembly Delay Press T68

ABSTRACT DATA

ABSTRACT DATA

Accession No.__________ AD__________

Picatinny Arsenal, Dover, New Jersey

DEVELOPMENT OF THE XM88 ELECTRIC PRIMER

Technical Report 3067, April 1963,
40 pp, figures, tables.
Unclassified report from the Artillery Ammunition Laboratory, Ammunition Group.

A button-type, 50-millisecond delay primer, designated Primer, Electric: XM88, was developed for incorporation in the PD, T212E6 and PD, XM566 Fuzes.

Groups of primers were function tested (at extreme and ambient temperatures) after water immersion, environmental conditioning, ballistic firing and subjection to 30,000 Gs, with the primer contact pin forward and base forward.

The development product fulfills the requirements for a delay initiator to be used in parallel with a superquick initiator, but the problem of sealing exists with the design of the plug assembly.

UNCLASSIFIED

1. Electric Primers -- Development
2. Point-Detonating Fuzes

I. Trezona, Ruth E.
II. XM88 Electric Primer
III. T212E6 PD Fuze
IV. XM566 PD Fuze

UNITERMS

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50-Millisecond
Delay
XM566
T212E6
Point-Detonating Fuze
Initiator
Trezona, Ruth E.

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